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Chapter Fifty-four

GEOMETRIC DESIGN OF EXISTING FREEWAYS (3R) & (4R) PARTIAL RECONSTRUCTION

54-1.0 GENERAL

54-1.01 Background

The Department began construction of its freeway system in the 1950's and, today, the Indiana system has been completed. The freeway system has introduced a level of mobility and safety for the traveling public which was unattainable without its special features, such as full control of access, wide roadway widths and higher design speeds.

The freeway system requires periodic repair and upgrading which exceeds the limits of normal maintenance. These capital improvements are defined as 3R freeway projects (resurfacing, restoration, and/or rehabilitation), partial reconstruction (4R) projects or full reconstruction (4R) projects. Chapter Fifty-four discusses the Department's design criteria for 3R and partial 4R reconstruction freeway projects. These criteria meet or exceed the criteria presented in AASHTO's *A Policy on Design Standards - Interstate System* and AASHTO's *A Policy on Geometric Design of Highways and Streets*. For full reconstruction projects, the designer should meet the criteria presented elsewhere in this *Manual*.

54-1.02 Applicability

54-1.02(01) Freeway Definition

Within the functional classification system, a freeway is the highest level of arterial. These facilities are characterized by full control of access, divided facilities with multi-lanes, high design speeds, and a high level of driver comfort and safety. Freeways include all Interstate highways in Indiana and any other route with full control of access (e.g., US 31 around South Bend, SR 912 in Lake County, Airport Expressway in Indianapolis). See Section 40-1.0 for more information on the functional classification system and the role of the freeway within the system.

54-1.02(02) Project Scope of Work

Section 40-6.01 defines the typical types of improvements that are usually made on 3R and reconstruction projects on the National Highway System (NHS). The following provides a general overview of what may represent a 3R freeway project or a freeway reconstruction project in Indiana. For a more in-depth description, the designer should review Section 40-6.01. For freeways, the distinction between freeway 3R, and partial reconstruction and complete reconstruction projects can be summarized as follows:

1. 3R Projects. Typical 3R freeway projects may include all or some of the following improvements.

    a. pavement resurfacing;

    b. full-depth pavement reconstruction, if the reconstructed pavement area is 30% or less of the traveled way;

    c. widening existing travel lanes or shoulders;

    d. upgrading the structural strength of shoulders;

    e. improving the superelevation of existing horizontal curves;

    f. adding auxiliary lanes;

    g. improving roadway delineation;

    h. upgrading roadside safety;

    i. increasing the length of acceleration and deceleration lanes at an interchange;

    j. widening an existing bridge as part of a bridge reconstruction project;

    k. upgrading or replacing bridge rails;

    l. overlaying bridge decks;

    m. preservation of bridge substructures;

n. improving roadside drainage;

o. widening an existing ramp;

p. flattening a horizontal or vertical curve; and/or

q. increasing the vertical clearance at underpasses.

2. Partial Reconstruction (4R) Projects. A freeway improvement is considered a partial reconstruction (4R) project when one or more of the following improvements will be made to the freeway.

a. a significant portion (over 30%) of the travelway pavement area must be removed and replaced,

b. a thick concrete overlay is required (over 150 mm) or a thick bituminous overlay (over 200 mm) is to be placed,

c. the facility cannot adequately accommodate the current or projected (10 year) traffic demand and additional lanes are necessary,

d. major revisions are necessary to the existing horizontal and vertical alignment requiring that over 30% of the travelway pavement must be replaced,

e. total bridge or bridge deck replacement is required,

f. bridge deck widening is necessary due to added travel lanes on the approach, and/or

g. interchange upgrading is required to meet current and projected (20 year) traffic demands.

3. Complete Reconstruction (4R) Projects. A freeway improvement is considered to be a complete reconstruction when the project intent is to replace the existing facility. Complete reconstruction will typically provide significant improvements in level of service, operational efficiency and safety. For complete freeway reconstruction projects, the criteria presented in Chapter Fifty-three should be used.

54-1.03 Objectives

The basic objective of a 3R/partial 4R freeway project is to improve the freeway's serviceability to meet future demands by extending the service life of the existing facility and enhancing highway safety. This objective applies to all aspects of the freeway's serviceability. If a project is classified as a partial 4R project, an additional objective, where practical, is to upgrade existing elements to new construction criteria. For example, where the pavement is to be replaced, it may be practical to improve the horizontal and/or vertical alignment.

54-1.04 Approach

3R/Partial 4R freeway projects are most often initiated to make a specific improvement to the freeway (e.g., resurfacing or roadside safety improvements). In addition, the Department's policy is to review and upgrade other design elements, wherever practical. The Department's 3R/partial 4R approach is summarized as follows:

1. Nature of Improvements. Identify the specific improvements intended for the 3R/partial 4R project. The designer should review Section 54-1.02(02) for typical freeway project improvements.

2. Numerical Criteria. INDOT's 3R/partial 4R freeway criteria are based on AASHTO *A Policy on Design Standards - Interstate System* and the AASHTO *Policy on Geometric Design of Highways and Streets* new construction/reconstruction criteria for freeways. Sections 54-2.0 through 54-6.0 provide INDOT's 3R/partial 4R freeway criteria. Unless stated in this Chapter, the freeway design criteria presented elsewhere in this *Manual* should be incorporated where practical.

3. Secondary Impacts. Identify and evaluate any secondary impacts which may be precipitated by the freeway improvement. For example:

    a. The installation of a CMB may restrict horizontal sight distance.
    b. A pavement overlay may reduce the vertical clearance requirements under bridges.
    c. A pavement overlay may require the adjustment of roadside barrier height.

4. Other Improvements. Identify any geometric design deficiencies within the project limits which can be practically corrected without exceeding the intended project scope of work. A review of the accident history is important in conducting this evaluation.

5. Exceptions. The discussion in Section 40-8.0 on design exceptions applies equally to the geometric design of 3R/partial 4R freeway projects. However, the designer will evaluate the proposed design against the criteria presented in this Chapter. When determining the need for a design exception, the designer should note that the minimum criteria for the following

items need only meet the AASHTO Interstate criteria that were in effect at the time of original construction or when the facility was incorporated into the Interstate system. These design elements include the following:

a. horizontal alignment, except superelevation;
b. vertical alignment;
c. shoulder widths; and
d. median widths.

54-1.05 3R/Partial 4R Project Evaluation

Sections 54-2.0 to 54-6.0 present the specific geometric design and roadside safety criteria which will be used to determine the design of 3R/partial 4R freeway projects. In addition, several other factors must be considered in a 3R/partial 4R freeway project, and the designer should conduct applicable evaluations as may be deemed necessary. These evaluations are discussed below.

1. Accident Experience. The historical accident data within the project limits will be evaluated. Accident data is available from the Pre-Engineering and Environment Division. Section 55-8.0 further describes the Department's accident analysis procedures.

2. Existing Geometrics. The designer will normally review the as-built plans and combine this with the field review and field survey (if conducted) to determine the existing geometrics within the project limits. This includes lane and shoulder widths, horizontal and vertical alignment, interchange geometrics and the roadside safety design.

3. Physical Constraints. The physical constraints within the limits of the project will often determine what geometric improvements are practical and cost-effective. These include topography, adjacent development, available right-of-way, utilities and environmental constraints (e.g., wetlands).

4. Field Review. The designer will normally conduct a thorough field review of the proposed project. Other personnel should attend the field review as appropriate, including personnel from District traffic, maintenance and construction units. The objective of the field review should be to identify potential safety hazards and potential safety improvements to the facility.

5. Pavement Condition. 3R/Partial 4R projects are often programmed because of a significant deterioration of the existing pavement structure. The extent of deterioration will determine the necessary level of pavement improvements, which may include milling of the existing pavement surface or replacement of the pavement. This decision will also influence the

extent of practical geometric improvements. For a freeway to be eligible for pavement resurfacing or replacement, the pavement should exhibit one or more of the following conditions:

a. alligator cracking,
b. bleeding,
c. block (cracking),
d. bumps (upheaval),
e. corrugation,
f. depression and rutting,
g. edge cracking,
h. longitudinal and transverse cracking,
i. patching or utility cut,
j. polished aggregate,
k. potholes,
l. slippage-cracking, and/or
m. weathering and raveling.

Pavement resurfacing or replacement will be based upon the design year traffic data (i.e., 10 years for resurfacing and 20 years for reconstruction). All pavement surfaces will be designed to incorporate skid resistance.

6. Geometric Design of Adjacent Highway Sections. The designer should examine the geometric features and operating speeds of the freeway sections adjacent to the project. This will include investigating whether or not any highway improvements are in the planning stages. The project should provide design continuity with the adjacent sections. This involves a consideration of factors such as driver expectancy, geometric design consistency and proper transitions between sections of different geometric designs.

7. Early Coordination for Right-of-Way Acquisition/Utilities. Significant R/W acquisitions are typically outside the scope of 3R/partial 4R freeway projects. However, the field review and accident or speed studies may indicate the need for selective safety improvements or other minor operational improvements which will require R/W purchases (e.g., interchange improvements). Therefore, the designer should, as early as feasible, determine improvements which will be incorporated into the project design and initiate the R/W acquisition process.

8. Maintenance and Protection of Traffic. A significant portion of the work will likely occur on the freeway itself. Therefore, maintenance and protection of traffic during construction will be an important consideration in project development. The protection of the highway construction workers is also an important factor. The designer should reference Part VIII for the Department's criteria on the design of work zones for traffic accommodation.

9. Traffic Control Devices. All signing and pavement markings on freeway projects must meet the criteria in Part VII and the *Manual on Uniform Traffic Control Devices* (MUTCD). The Design Division's Specialty Projects Group is typically responsible for selecting, locating and analyzing the adequacy of breakaway and yielding sign and light supports on the project. However, the designer should work with the Design Division's Specialty Projects Group to identify possible geometric and safety deficiencies which will remain in place (i.e., no improvement will be made). The Specialty Projects Group will then determine if additional signing, traffic control devices or delineation treatments are warranted.

10. Document the Design Process. The Environment, Planning and Engineering Division will prepare the Engineer's Report which will typically address the following:

    a. existing geometric and roadside features, traffic volumes and speeds, and accident history;

    b. applicable minimum design criteria;

    c. specific safety problems or concerns raised by a review of accident data, by a field inspection, or by the public;

    d. design options for correcting safety problems and the cost, safety and other relevant impacts of these options;

    e. proposed exceptions to applicable design criteria and the rationale to support the exceptions; and

    f. the recommended design proposal.

    The Environment, Planning and Engineering Division will identify any design exceptions that will be required on the 3R/partial 4R freeway project. The designer will be responsible for the preparation of the design exception requests (See Section 40-8.0).

Each urban added travel lanes project should be classified as 4R rather than 3R if the work actually consists of increasing the number of through travel lanes. The geometric design criteria from Chapter Fifty-three will apply. If any Level Two design criteria, such as clear zone width requirements, cannot be met, suitable documentation should be provided in the project file and in the Design Summary. The addition of a continuous two-way left turn lane to an existing two lane or four lane section may still be categorized as 3R construction.

The misclassification of an urban added travel lanes project has occurred most often with local public agency work. Each new 4R project, both INDOT and local agency, should be developed with

a full clear zone in accordance with Chapter Forty-nine. An older urban added travel lane project that was initially developed as a 3R project and switched to 4R may be allowed to continue to final design with a substandard clear zone, provided that the acceptable Level Two documentation has been furnished.

Roadside safety should be considered before providing a substandard clear zone on an urban added travel lanes project. For example, it would not be appropriate to omit the clear zone and simply provide the minimum 3R obstruction free zone of 0.5 m if this means that utility poles would be located immediately behind the curb of a new 4R facility in a suburban area. An obstruction free zone equivalent to the clear zone should be provided if practical. Consequently, for a 4R project with barrier curbs, a 3.0-m obstruction free zone should be provided if the required clear zone cannot be provided. No obstructions or hazards other than non-recoverable sideslopes and ditches will be permitted within this obstruction free zone.

Where the full clear zone is not provided, documentation should be prepared in accordance with Section 40-8.02(02), with detailed discussion of the merits of right-of-way cost savings versus safety considerations. The Level Two documentation must be conclusive with respect to the rationale for the Level Two exception. If a meeting was held regarding the exception, the date and the attendees should be referenced. Level Two documentation should be submitted at the preliminary field check stage and should be briefly summarized in the Design Summary.

54-2.0 TABLE OF 3R/PARTIAL 4R FREEWAY GEOMETRIC DESIGN VALUES

Figure 54-2A, Geometric Design Criteria for Freeways (3R / Partial 4R Projects) presents the Department's criteria for the design of 3R/partial 4R freeway projects for both rural and urban areas. The designer should consider the following in the use of the table.

1. Manual Section References. These tables are intended to provide a concise listing of design values for easy use. However, the designer should review the appropriate section references for greater insight into the design elements.

2. Footnotes. The tables include many footnotes, which are identified by a number in parentheses (e.g., (6)). The information in the footnotes is critical to the proper use of the design tables.

3. Controlling Design Criteria. The 3R/partial 4R table of geometric design criteria provides an asterisk to indicate controlling design criteria. The designer will evaluate the proposed design against the criteria presented in Table 54-2A and elsewhere in this Chapter.

4. Design Exceptions. These standards are for use on existing freeways including those on the National Highway System. They are to be used for all projects that are classified as 3R or partial reconstruction regardless of funding source. In other words, any 3R or partial reconstruction work, whether Federal-aid funded or not, must meet these standards. Deviation from controlling design criteria should be covered by an approved design exception. Also, any operational or maintenance changes, permanent or temporary, exclusive of work zone traffic control that in fact create substandard conditions such as by re-striping to obtain added lane(s) by reducing existing lane widths and/or shoulders, must be covered by design exceptions whether or not actual construction or reconstruction is involved.

   Design exception requests for Level One design criteria on the following:

   a) Non-Exempt FHWA Funded Projects on the NHS require FHWA Approval.
   b) Exempt FHWA funded Projects on the NHS require Chief, Division of Design approval.
   c) Non-FHWA Federally Funded Projects on the NHS require Chief, Division of Design approval with an information copy sent to FHWA.
   d) Projects not on the NHS require Chief, Division of Design approval

54-3.0 GEOMETRIC DESIGN

Table 54-2A presents the Department's criteria for the geometric design of 3R/partial 4R freeway projects. However, the designer must still make certain decisions, and there is some flexibility that can be applied. These are discussed in the following sections.

As an additional evaluation factor, the design criteria used for horizontal alignment, excluding superelevation, vertical alignment and widths of median and shoulders for 3R/partial 4R freeway projects may be the AASHTO Interstate criteria that were in effect at the time of original construction or inclusion into the Interstate system.

54-3.01 Design Controls

54-3.01(01) Traffic Volume Analysis

The following traffic volume controls will apply to 3R/partial 4R freeway projects.

1. Design Year. The pavement resurfacing portion of a 3R project should be designed using a 10-year design life. All other elements of the facility should have a design life of 20 years beyond the expected construction date.

2. Level of Service (LOS). Table 54-2A provides the desirable and minimum LOS criteria for 3R/partial 4R projects. The geometric design elements of the freeway should be designed to meet the level-of-service criteria for a DHV 20 years beyond the expected completion date.

3. Traffic Data. The designer should obtain the necessary traffic data from the Environment, Planning and Engineering Division. This should include current and future (10 and 20 years) ADT, DHV, percent of trucks and buses (including interchanges), accident data for the most recent 3-year period, and any known future traffic impact.

4. Capacity Analysis. The analytical techniques in the *Highway Capacity Manual* and Chapter Forty-one will be used to conduct the capacity analysis.

54-3.01(02) Design Speed

Chapter Fifty-three presents the Department's criteria for selecting the design speed for new construction and complete 4R freeway projects. Desirably, these will also apply to 3R/partial 4R freeway projects. At a minimum, the original construction design speed may be used. Under restricted urban conditions, the existing posted speed limit may be used as the design speed.
The design speed selected must equal or exceed the existing posted speed limit or a design exception will be required. See Section 40-4.0 for additional information on design speed.

54-3.02 Horizontal/Vertical Alignment

Unless the specific objective of the freeway project is to improve one or more horizontal/vertical features, the existing alignment will normally be acceptable if the following two conditions are met:

1. the design meets the AASHTO Interstate criteria that were in effect at the time of original construction or inclusion into the Interstate system, and

2. a review of the accident history for the past three years does not indicate a problem.

Once the decision has been made to reconstruct a horizontal/vertical alignment feature, the designer will apply the criteria in Chapters Forty-three or Forty-four.

54-3.02(01) Superelevation

On horizontal curves where the existing radius will be retained, it may be necessary to make improvements to the superelevation. This may require revising the pavement resurfacing thickness on horizontal curves to meet the superelevation criteria in Sections 43-2.0 and 43-3.0. Where the pavement structure will be reconstructed, the superelevation design should meet the new construction criteria presented in Sections 43-2.0 and 43-3.0.

54-3.02(02) Grades

The maximum grades are presented in Table 54-2A.

54-3.02(03) Vertical Clearances

The minimum vertical clearance is 4.90 m over the entire roadway including the usable shoulder widths for both the left and right shoulders. If practical, the 4.90-m clearance should be provided for all overpasses within the 3R/partial 4R freeway project. If the 4.90-m clearance cannot be obtained, then a design exception will be required. However, for the routes listed below in Marion County, existing overpasses with a vertical clearance of at least 4.30-m may be retained without a design exception.

1. I-65 from I-465 South to I-465 North,
2. I-70 from I-465 East to I-465 West, and
3. I-465 from I-69 Westward to I-65 North.

(Note: It is Department policy to provide a "low-clearance" sign on all structures with vertical clearances less than 4.45 m.)

54-3.03 Cross Sections

54-3.03(01) Lane and Shoulder Widths

All travel lane and shoulder widths not meeting the criteria in Table 54-2A should be evaluated for widening. The designer needs to consider the following:

1. Travel Lanes. INDOT policy is to provide 3.6-m travel lanes and auxiliary lanes on all freeways.

2. Shoulders. Existing shoulder widths may be retained if they meet the AASHTO Interstate criteria in effect at the time of original construction or inclusion into the Interstate system.

54-3.03(02) Curbs

On 3R/partial 4R freeway projects, the following will apply to the installation or retention of curbs.

1. Safety Considerations. All existing curbs should be removed for safety reasons, unless they are required for drainage.

2. Types. If curbing is required for drainage, only sloping curbs will be permitted.

3. Guardrail. Curbs in front of guardrail may cause an errant vehicle to vault over or break through the barrier. Where guardrail is used and curbing is necessary for drainage, the maximum curb height should be 100 mm and placed behind the face of guardrail. To accomplish this, the guardrail post must be driven immediately behind the back of the curb.

54-3.03(03) Medians

The following will apply to medians on 3R/partial 4R freeway projects.

1. Widths. In general, existing median widths will be retained.

2. Parallel Slopes. Existing slopes of 4:1 or flatter will generally be retained. If existing slopes are flattened, the designer should consider the effect on drainage within the median.

3. Transverse Slopes. All transverse slopes for ditch checks and median crossovers within the median will be 10:1 or flatter.

4. Median Openings. See Section 54-6.0 for information on freeway median openings.

54-3.03(04) Fill/Cut Slopes

The following will apply to fill and cut slopes within the limits of a 3R/partial 4R freeway project.

1. No Roadway Widening. Existing 2:1 or flatter fill and cut slopes will typically be retained. However, slopes steeper than 4:1 should be evaluated for flattening.

2. Roadway Widening. If the lane and/or shoulders are widened as part of the project, this will produce a steeper fill slope or ditch foreslope (assuming the toe of fill slope or toe of backslope remains in the same location). Desirably, the designer will modify the roadside design to provide a configuration which is the same as or flatter than the roadside cross section before the project. As a minimum, the following will apply:

    a. Embankment slopes. Fill slopes or ditch foreslopes beginning at the shoulder break should not exceed 4:1 unless steeper slopes can be justified by an engineering and economic analysis. If the slopes can be flattened beyond 4:1, the designer should desirably provide a 6:1 slope at least within the clear zone.

    b. Ditches. If right-of-way is available, the existing ditch line should be moved outward and slopes flattened as much as practical. Drainage ditches within the clear zone should be regraded as much as practical to make them traversable for errant vehicles. See Section 49-3.02 for information on traversable ditches.

    c. Embankment Stability. In all cases, stable embankment material must be used and placed in accordance with the INDOT *Standard Specifications*. Sod or other appropriate materials or methods should be provided wherever erosion may be considered a problem.

3. Roadside Safety. Upgrading the roadside safety of the freeway is often a major objective of the 3R/partial 4R project. On all 3R/partial 4R freeway projects, the designer should consider the safety benefits of flattening fill and cut slopes to eliminate guardrail and, at a minimum, to meet the criteria presented in Item 2 above. An evaluation of run-off-the-road accidents will assist in the assessment (see Chapter Fifty). See Section 54-4.0 for more information on roadside safety criteria for 3R/4R projects.

54-3.03(05) Right-of-Way

Wherever practical, additional right-of-way should be secured to allow cost-effective geometric and roadside safety improvements.

54-3.03(06) Interchanges

A 3R\partial 4R freeway project may include proposed work on a freeway interchange. Typically, this work will only include selective improvements to the interchange geometrics. For example, this may include lengthening acceleration/deceleration lanes, clearing the gore area, correcting the ramp superelevation, etc. When evaluating work on interchanges, the designer should consider the following:

1. Desirable. The criteria presented in Chapter Forty-eight should desirably be used to design all interchange elements which will be improved as part of the freeway project.

2. Minimum. The criteria presented in the *AASHTO A Policy on Geometric Design of Highways and Streets* may be used as the minimum design where INDOT's criteria exceeds AASHTO's. For example, Figure 54-3A, Lengths for Deceleration, and Figure 54-3B, Grade Adjustments for Deceleration, may be used to determine deceleration distances for freeway exits instead of INDOT's standard 300-m length.

3. Acceleration/Deceleration Lanes. INDOT practice is to only use parallel freeway/ramp exits and entrances; see Section 48-4.0. When converting taper designs to the preferred parallel design, the existing taper portion less than 3.6-m wide will need to be removed and reconstructed to provide the full 3.6-m width for the entire acceleration/deceleration length.

4. Ramp Shoulders. Under restrictive conditions, existing right shoulder widths of 2.3-m may be retained.

54-4.0 ROADSIDE SAFETY

All 3R/partial 4R freeway projects will be evaluated for potential roadside safety improvements within the project limits. The criteria presented in Chapter Forty-nine will fully apply to the evaluation. This includes roadside clear zones, barrier warrants (See Figure 49-4G_1), barrier design and drainage features.

54-5.0 BRIDGES

54-5.01 General

Table 54-2A, Geometric Design Criteria for Freeways (3R / Partial 4R Projects), provides the Department's criteria for structural capacity and widths for new and reconstructed bridges within a 3R/partial 4R freeway project and for existing bridges to remain in place within the limits of a 3R/partial 4R freeway project. Existing bridges may remain in place if they meet, or are upgraded to meet, the structural and geometric requirements presented in Table 54-2A and in Section 54-5.02. Upgrading a bridge to meet these criteria may be considered if an engineering analysis determines that the upgrading is appropriate. Some of the items that should be considered in the analysis include the following:

1. remaining service life,
2. sufficiency rating,
3. traffic volumes,
4. clear roadway width,
5. design speed, and
6. accident records.

If it is determined that a bridge should be replaced or undergo major reconstruction (e.g., replacing superstructure, widening superstructure or substructure), the design will meet current AASHTO criteria and load carrying capacity (see Part VI).

54-5.02 Bridges To Remain In Place

An existing bridge within the limits of a freeway project should be evaluated for possible upgrading or replacement (see Section 54-5.01), if it does not meet the following criteria.

1. Width. The width of the existing bridge should be evaluated against the criteria in Table 54-2A.

2. Structural Capacity. The structural capacity of the existing bridge should be evaluated against the criteria in Table 54-2A.

3. Vertical Clearance. Existing structures should provide at least a 4.90-m vertical clearance over the entire roadway including the usable shoulder widths for both left and right shoulders. If it is necessary to retain a vertical clearance of less than 4.90 m, then a design exception request will be necessary according to Section 40-8.0. However, Section 54-3.02 provides a list of routes where existing overpasses with a minimum 4.30-m vertical clearance may be retained without a design exception. Low clearance signs are required on all bridges with less than a 4.45-m vertical clearance.

4. Bridge Railings. Only existing bridge rails that have been proven to be acceptable through crash testing may be retained. All new bridge rail installations will meet the Department's current criteria (see Part VI). Consideration should be given to widening the bridge at the same time the railing is replaced to achieve the full approach roadway width.

5. Approach Barrier Transitions. All approaching barrier transitions must meet current INDOT criteria. See Chapter Forty-nine and the INDOT *Standard Drawings*.

54-6.0 MEDIAN OPENINGS ON FREEWAYS

On fully access-controlled freeways, median crossings are denied to the public. However, occasional median openings or emergency crossovers are required to accommodate maintenance and emergency service vehicles.

54-6.01 Guidelines

Median openings on freeways are required to facilitate maintenance operations such as snow plowing and emergency vehicles. These crossovers should be placed well away from any mainline conflicts, such as interchanges. In general, the number and location of median crossovers should be kept to a minimum. The following provides general guidelines for determining the location of crossovers on freeways.

1. Spacing. Median openings may be provided if they meet the following spacing requirements.

    a. A median crossover may be provided approximately half way between interchanges when the spacing between interchanges is greater than 5 km but, less than 7 km.

    b. Multiple crossovers may be provided so that the distance between each crossover and/or interchange is not greater than 5 km when the spacing between interchanges is greater than 7 km.

2. Jurisdictions. Maintenance crossovers may be appropriate at State lines or division lines between maintenance districts or subdistricts.

3. Urban. Crossovers are not normally located in urban areas or areas with narrow medians.

4. Interstates. Section 54-6.04 provides a listing of the FHWA approved crossover sites on the Interstate system within Indiana.

5. Interchanges, Rest Areas and Weigh Stations. Crossovers may be located at both ends of an interchange, rest area or weigh station.

54-6.02 Implementation

If warranted as discussed in Section 54-6.01, all new crossovers on existing facilities should meet the design criteria presented in 54-6.03. The addition of median crossovers, either during construction or after the highway is in use, requires the approval of the Chief Engineer of the Indiana Department of Transportation and concurrence from the FHWA.

54-6.03 Design

The INDOT *Standard Drawings* provide the criteria for the proper design of a freeway crossover. In addition, the designer should consider the following:

1. Interchanges and Lane Drops. Desirably, the crossover should be at least 450 m from the termini of an exit ramp, entrance ramp and/or lane drop.

2. Structures. Crossovers should be located at least 450 m from any structure crossing over the freeway.

3. Weigh Stations and Rest Areas. Crossovers near weigh stations and rest areas should be at least 450 m from the end of the exit or entrance ramp taper for the weigh station and/or rest area.

4. Sight Distance. Because of the unexpected U-turn maneuver, adequate sight distance should be available when vehicles make U-turns on freeways. Desirably, decision sight distance should be provided in both directions at a crossover. This would favor, for example, placing a crossover in a sag vertical curve. At a minimum, the minimum stopping sight distance should be provided.

5. Median Barriers. Emergency crossovers should be avoided where a median barrier is present. If a crossover must be provided, the barrier should be flared as shown in Figure 54-6A, Barrier Treatment at a Median Crossover, or terminated with an appropriate end

treatment as discussed in Chapter Forty-nine. The width of the opening should not be greater than 11.5-m wide.

6. Horizontal Curves. Preferably, crossovers should not be located within curves requiring superelevation.

7. Pavement. The crossover pavement will generally be constructed with an asphalt surface of sufficient strength to accommodate the largest expected vehicle (e.g., fully loaded dump truck, fire truck). See Chapter Fifty-two.

8. Drainage. Crossovers should be located such that an additional drainage structure would not be required. The designer should review the median drainage patterns to ensure that the median crossover will not negatively disrupt the median drainage (e.g., cause ponding in the median). If culverts are required under the crossover, special consideration should be given to providing inlets or culvert end sections which meet the criteria in Section 49-3.03 and the INDOT *Standard Drawings*.

54-6.04 Locations for Interstate Crossovers

The FHWA-approved sites for median crossovers on the Interstate system are listed in Figure 54-6B(64) for I-64, Figure 54-6B(65) for I-65, Figure 54-6B(69) for I-69, Figure 54-6B(70) for I-70, Figure 54-6B(74) for I-74, Figure 54-6B(94) for I-94, and Figure 54-6B(100) for the three-digit-numbered routes. The sites are listed according to the district, reference marker, and location description.